University of Belgrade
Technical Faculty in Bor

Chamber of Commerce
and Industry of Serbia

XV International Mineral Processing & Recycling Conference

IMPRC
INTERNATIONAL MINERAL PROCESSING & RECYCLING CONFERENCE

Proceedings

Editors:
Jovica Sokolović
Milan Trumić

17-19 May 2023 | Belgrade SERBIA

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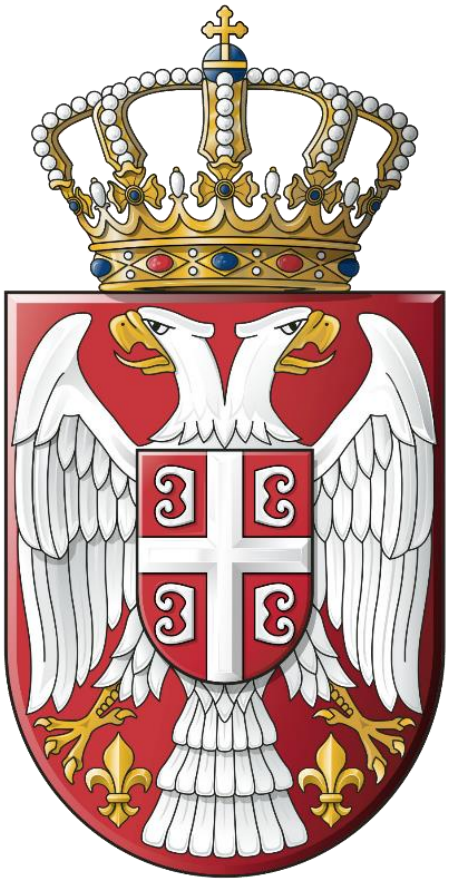

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APPLICATION OF SUSTAINABLE CYCLING MANAGEMENT SYSTEM IN PHYTOREMEDIATION TECHNOLOGY OF CONTAMINATED SOILS

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ABSTRACT – Mining and metallurgy activities in the Bor area have a big influence on water, air and soil quality. Phytoremediation technology can solve this problem but produces hazardous biowaste. Because of that, it is necessary to develop Sustainable Cycling Management System in Phytoremediation Technology (SCMS-PT) for contaminated soils, as is presented in this paper.

Keywords: Phytoremediation Technology Sustainable Cycling Management System, Contaminated Soil.

INTRODUCTION

Mining and metallurgy activities in the Bor area have a big influence on water, air and soil quality. The main pollution in the Bor area become from mining waste that is deposed many years ago and generates acid main drainage and from ongoing mining activity, drainage water from the flotation tailings which are no longer in function. The main pollutants are heavy metals (HM), but also, because of the directly discharged of urban wastewater without treatment, organic pollutants are present [1,2]. Also, air pollution is present. High concentrations of suspended particles are sufficient to cause adverse health effects, including increased morbidity or mortality. There is only one automatic measurement station that measures PM10 in the Bor Agglomeration and there is not enough data for the PM10 assessment but according to the existing data, air quality in Bor was very poor in the time period 2006-2010, regarding levels of As in total suspended particles [3].

Phytoremediation is a remediation technology to remove pollutants from contaminated soil, water or sediments by using plants. It is eco-friendly green engineering technology. Soil contamination by various inorganic and organic compounds can be clean-up by phytoremediation. The process involves the accumulation of pollutants, including heavy metals, into the plant through its root structure from the surrounding soil, water or sediments [4-8].

The plant biomass, the product of the phytoremediation technology, contains heavy metals (HM) and present highly contaminated bio-waste and it is a difficult problem for the phytoremediation technology, because could easily become a secondary pollution

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source if mishandled. The bio-waste is hazardous waste. Thus, appropriate disposal and utilization methods for such biowaste are required.

In this paper are presented solution for problem of contaminated soil in Bor area by developing the Sustainable Cycling Management System in phytoremediation technology (SCMS-PT).

MATERIAL AND METHOD

In Bor area phytoremediation technology can be applied Ex-situ and In-Situ, continually and induces to clean up contaminated area of toxic metals. We chose to based our model of SCMS on In-Situ phytoremediation technology.

Phytoremediation process

In -situ Phytoremediation process are consisting of following phases:

1. Identification of sub-area in Bor region for implementation CMS-PT
2. Chemical analysis of the contaminated soil (determination of inorganic and organic pollutants)
3. Determine the plant that already grow in investigated area and determine accumulation efficiency of all part of plats
4. Perform in-situ phytoremediation based on selected plants
5. Picking and drying the plants
6. Chemical analysis of the soil near the root after finished phytoremediation
7. Determination of co-efficient (Concentration factors) of plants.

Establishment sustainable cycle management system of contaminated soil phytoremediation process products

Sustainable cycle management system of contaminated soil phytoremediation process products from Bor area are consisting of following phases:

1. incineration,
2. leaching, and
3. solid waste stabilization after the leaching process.

RESULTS AND DISCUSSION

SCMS -PT system for investigated Bor area will give following data:

- ✓ *In-situ Phytoremediation process* followed by chemical analysis of contaminated bio waste will give data for prediction of number of phytoremediation process cycles needed for clean-up of contaminated soil in investigated Bor area based on selected plants.
- ✓ *Established sustainable cycle management system of contaminated soil phytoremediation process products will give data of the process of incineration includes investigation of calorific value of tested plant samples with aim of economical view of the selected process as well as chemical composition of ash. Beyond of mentioned parameters, follows the analyses that includes an elemental analysis of plant samples (C,*

H, N, S), technical analysis of plant samples (moisture, ash, volatile content) with aim of ecological view of selected process (CO_2 and SO_2 emission in air). Incineration ash treatment: leaching process, treatment of obtained leaching solution, treatment of solid residue after leaching (if needed). The treatment process of solid residue, includes investigation of stabilization agent and optimal ratio waste to an agent in aim to obtained new product with possibilities of civil construction usage or similar.

The proposed SCMC-PT system solves the problem of contaminated soil, but in the first step, it is very good for application because it has a big influence on decreasing the contamination spread by air. The proposed SCMC-PT system (incineration, leaching, stabilization, and usage in civil construction) has its own advantages and disadvantages. SCMC-PT system presented zero-waste process. However, there are not many studies on this aspect. Thus, it will be the future task to continue studying the technical parameters and mechanism of the combination methods.

CONCLUSION

Application of phytoremediation technology in Bor area is not enough to solve environmental problem, because of a big risk of secondary pollution from remaining hazardous biowaste.

Cycling Management System in phytoremediation technology (CMS-PT) should be investigated on smaller area and based on obtained result established Sustainable Cycling Management System in phytoremediation technology (SCMS-PT), that also should be in future studying and continuously upgrading.

Proposed SCMS-PT for Bor area consisted of: in-situ phytoremediation process, incineration, leaching process of ash from incineration, treatment of obtained leaching solution, treatment of solid residue after leaching (as zero-waste process).

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